AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method for receiving high frequency signals transmitted through free space, comprising:

passing one or more optical signals, the one or more optical signals containing data and being composed of radiation of a plurality of differing wavelengths, through a diffractive optical element to form a plurality of signal segments, each signal segment having a different mean wavelength;

passing a portion of a beam comprising each of said one or more optical signals through a phase retarder that is provided separately from said diffractive optical element, wherein said portion of said beam passed through the phase retarder comprises an area of the beam that is less than a total area of the beam in cross-section, and

detecting data in each of said plurality of signal segments at or near a different spatial focal point.

2. (Original) A method, as claimed in Claim 1, further comprising, before the passing step:

transmitting each of said optical signals through atmospheric distortion at a data rate that is greater than one gigabit/second for each wavelength.

3. (Original) A method, as claimed in Claim 1, wherein the diffractive optical element is a hologram, a zone plate, or combination thereof.

4. (Currently Amended) A method, as claimed in Claim 3, wherein said phase retarder has an area that is less than an area of said diffractive optical element, wherein a first portion of the optical signal is passed through said phase retarder, wherein said phase retarder defines a disc shaped area that is located in ~~at least~~ a central portion of the diffractive optical element, and wherein the first portion of the optical signal has a

different phase than a second portion of the optical signal that is not passed through the phase retarder and wherein said first portion is the radiation in the optical signal that contacts the diffractive optical element within a first radial distance of a center of the diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

5. (Original) A method, as claimed in Claim 1, wherein:

in the detecting step, each of the plurality of signal segments is detected by a different detector.

6. (Original) A method, as claimed in Claim 1, wherein:

in the detecting step, the mean wavelength of at least one of the signal segments is reduced before the at least one of the signal segments contacts a detector.

7. (Original) A method, as claimed in Claim 6, wherein at least one of the following conditions is true before a signal segment contacts a detector:

the spot size of the signal segment is reduced by a lens;

the mean wavelength of the signal segment is reduced by a lens; and

the intensity of a signal segment is increased by a lens.

8. (Original) A method, as claimed in Claim 1, wherein:

after the passing step and before the detecting step, the plurality of signal segments are reflected by a reflective surface.

9. (Original) A method, as claimed in Claim 1, wherein:

the optical signal has a beam size at an aperture of a source transmitter associated with the optical signal that is less than an atmospheric inner scale.

10. (Original) A method, as claimed in Claim 9, wherein the beam size at the transmitter is no more than about 10 mm.

11. (Currently Amended) A method for receiving high frequency signals transmitted through free space, comprising:

dividing an optical signal, the optical signal containing data and being composed of radiation of a plurality of differing wavelengths, into a plurality of signal segments, each signal segment having a different mean wavelength;

passing a portion of one of the divided optical signal and the optical signal through a phase retarder;

reflecting said divided signals towards a plurality of spaced apart detectors;

reducing the spot size of the signal segments using an immersion lens that is integral to each of the plurality of detectors; and

detecting, with said plurality of spaced apart detectors data in each of said plurality of signal segments, wherein each of said spaced apart detectors is located substantially at a different focal point, the focal points being at different positions along a common optical axis.

12. (Original) A method of Claim 11, wherein each of the detectors in located in an end-to-end configuration relative to an adjacent detector.

13. (Original) The method of Claim 12, wherein the longitudinal axes of each of the detectors are at least substantially parallel to one another.

14. (Original) The method of Claim 13, wherein the longitudinal axes are at least substantially collinear.

15. (Original) The method of Claim 11, wherein in the dividing step the optical signal is passed through a diffractive optical element and a first portion of the optical signal is passed through one or more phase retarders.

16. (Original) A method, as claimed in Claim 15, wherein:

the first portion of the optical signal contacts a central portion of the diffractive optical element and wherein the first portion of the optical signal has a different phase than a second portion of the optical signal that is not passed through the one or more phase retarders.

17. (Original) A method, as claimed in Claim 15, wherein:

said first portion is the radiation in the optical signal that contacts the diffractive optical element within a radial distance of a center of the diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

18. (Original) A method, as claimed in Claim 11, wherein:

in the detecting step, the spot size of at least one of the signal segments is reduced by a lens before the at least one of the signal segments contact a detector.

19. (Original) A method, as claimed in Claim 18, wherein:

the spot size is reduced by an immersion lens.

20. (Previously Presented) A method, as claimed in Claim 11, wherein:

the plurality of signal segments are reflected by a reflective surface after the dividing step and before the detecting step.

21. (Original) A method, as claimed in Claim 11, wherein in the dividing step: said optical signal is focused with a diffractive optical element.

22. (Original) A method, as claimed in Claim 11, wherein:

the optical signal has a beam size at an aperture of a source transmitter associated with the optical signal that is less than an atmospheric inner scale.

23. (Original) A method, as claimed in Claim 22, wherein the beam size is no more than about 10 mm.

24. (Currently Amended) An apparatus for receiving an optical signal transmitted through free space, the optical signal being composed of radiation of a plurality of wavelengths, comprising:

at least one diffractive optical element for focusing radiation of different wavelengths at different corresponding focal points, wherein said focal points are at different positions along the optical axis of said optical element, wherein said at least one diffractive optical element has a diameter that is greater than a Fresnel scale for said plurality of wavelengths and a distance from a transmitter, and wherein said focal points encompass a first area comprising a first spot size or greater; and

a plurality of detectors, each detector being located at or near a different one of the focal points and receiving the radiation focused on the focal point corresponding to the detector, wherein each of the plurality of detectors has a photoactive area equal to a second area that is less than said first area, wherein each of said plurality of detectors is associated with a focusing element comprising an immersion lens that reduces the spot size of incident radiation to no more than said second area.

25. (Canceled)

26. (Currently Amended) An apparatus, as claimed in Claim 24, wherein:

~~said focusing elements each comprise an immersion lens, wherein~~ one of said immersion lenses is ~~located between~~ <u>associated with</u> each of the detectors ~~and the at least one diffractive optical element~~ to reduce the spot size associated with radiation converging on the respective detector.

27. (Original) An apparatus, as claimed in Claim 24, further comprising:

a reflective surface positioned on a first side of the at least one diffractive optical element.

28. (Original) An apparatus, as claimed in Claim 27, wherein:

at least some of the plurality of detectors are located in a hole in the at least one diffractive optical element.

29. (Original) An apparatus, as claimed in Claim 27, wherein:

at least some of the plurality of detectors are located on a second side of the one or more diffractive optical elements , the second side being in an opposing relationship with the first side.

30. (Original) An apparatus, as claimed in Claim 27, wherein:

the plurality of detectors are located between the reflective surface and the at least one diffractive optical element and along an axis of the at least one diffractive optical element.

31. (Original) An apparatus, as claimed in Claim 24, wherein:

the at least one diffractive optical element has an obscuration and at least one of the plurality of detectors is located in a shadow of the obscuration with respect to

radiation having a wavelength different from a wavelength of radiation converging on the at least one detector.

32. (Original) An apparatus, as claimed in Claim 26, wherein:

at least one of the detectors is integral with the corresponding immersion lens.

33. (Original) An apparatus, as claimed in Claim 26, wherein:

a plurality of the immersion lenses and a corresponding number of detectors have at least substantially parallel and collinear central axes and the central axes of the immersion lenses and corresponding detectors are at least substantially parallel and collinear with an optical axis of the at least one diffractive optical element.

34. (Original) An apparatus, as claimed in Claim 24, wherein an aperture size of the holographic unit exceeds the Fresnel scale.

35. (Currently Amended) An apparatus for receiving an optical signal transmitted through free space, the optical signal containing data, comprising:

a first holographic element for focusing radiation including a number of different wavelengths, wherein each wavelength is focused to a different point;

a phase retarder having an area that is less than an area of the first holographic element, wherein the phase retarder has a maximum radius that is no greater than 80% of a radius of the first holographic element;

a number of detectors; and

a number of second lenses, wherein one of said second lenses is located between the first lens and an associated detector, the second lens reducing a spot size of the focused radiation after passing through the second lens.

36. (Previously Presented) An apparatus, as claimed in Claim 35, further comprising:

a plurality of detectors, each detector being located at or near a respective focal point and receiving the radiation focused on the respective focal point.

37. (Original) An apparatus, as claimed in Claim 36, wherein:

the plurality of detectors are positioned at spaced apart locations along an axis of the first lens.

38. (Currently Amended) An apparatus, as claimed in Claim 36, wherein:

each of the second lenses is an immersion lens.

39. (Original) An apparatus, as claimed in Claim 36, further comprising:

a reflective surface positioned on a first side of the first lens.

40. (Original) An apparatus, as claimed in Claim 39, wherein:

at least some of the plurality of detectors are located in a hole in the first lens.

41. (Original) An apparatus, as claimed in Claim 39, wherein:

at least some of the plurality of detectors are located on a second side of the first lens, the second side being in an opposing relationship with the first side.

42. (Original) An apparatus, as claimed in Claim 39, wherein:

the plurality of detectors are located between the reflective surface and the first lens and along an axis of the first lens.

43. (Original) An apparatus, as claimed in Claim 36, wherein:

the first lens has an obscuration and at least one of the plurality of detectors is located in a shadow of the obscuration with respect to radiation having a wavelength different from a wavelength of radiation converging on the at least one detector.

44. (Original) An apparatus, as claimed in Claim 38, wherein:

at least one of the detectors is integral with the respective immersion lens.

45. (Original) An apparatus, as claimed in Claim 35, wherein the second lens is an immersion lens having an index of refraction of at least about 2.3, having a radius of curvature ranging from about 400 to about 600 microns.

46. (Original) An apparatus, as claimed in Claim 35, wherein the second lens has a radius ranging from about 200 to about 300 microns.

47. (Currently Amended) A method for receiving high frequency signals transmitted through free space, comprising:

first passing an optical signal, the optical signal containing data, through a first lens comprising a diffractive optical element provided as part of a receiver to form focused radiation having a first mean wavelength, wherein said first lens subtends at least about 50 microradians of a beam comprising the optical signal, ~~and~~ wherein at the receiver the optical signal has an angle of divergence of at least 20 microradians, and wherein less than all of the optical signal containing data is passed through a phase retarder that is provided separately from the diffractive optical element;

second passing the focused radiation through a second lens to form converging radiation having a second mean wavelength, the first mean wavelength being different than the second mean wavelength; and

detecting data in the convergent radiation.

48. (Original) A method, as claimed in Claim 47, wherein:

the optical signal is composed of radiation of a plurality of differing wavelengths; in the first passing step the first lens is a diffractive optical element; the focused radiation includes a plurality of signal segments, each signal segment having a different mean wavelength; and in the first passing step only a first portion of the optical signal is passed through a phase retarder.

49. (Original) A method, as claimed in Claim 47, further comprising, before the first passing step:

transmitting said optical signal through atmospheric distortion at a first rate that is greater than one gigabit/second.

50. (Original) A method, as claimed in Claim 48, wherein:

the first portion of the optical signal contacts a central portion of the diffractive optical element and wherein the first portion of the optical signal has a different phase than a second portion of the optical signal that is not passed through the phase retarder.

51. (Original) A method, as claimed in Claim 50, wherein:

said first portion is the radiation in the optical signal that contacts the diffractive optical element within a radial distance of a center of the diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

52. (Original) A method, as claimed in Claim 47, wherein:

in the detecting step, each of the plurality of signal segments is detected by a different detector.

53. (Original) A method, as claimed in Claim 47, wherein:

the second lens is an immersion lens.

54. (Original) A method, as claimed in Claim 48, wherein:

after the first passing step and before the second passing step, the plurality of signal segments are reflected by a reflective surface.

55. (Original) A method, as claimed in Claim 47, wherein:

the optical signal has a beam size at an aperture of a source transmitter associated with the optical signal that is less than an inner scale.

56. (Original) A method, as claimed in Claim 55, wherein the beam size is no more than about 10 mm.

57. (Currently Amended) An apparatus for receiving an optical signal, the optical signal containing data, comprising:

a first optical element for focusing a set of different optical wavelengths in the optical signal at different locations along a first optical axis of said first optical element;

a reflective surface for reflecting the focused set of different optical signals and forming a reflected set of different optical signals; and

a number of detectors, wherein each detector is associated with an immersion lens, wherein [[a]] the immersion lens of each detector is positioned to receive ~~each~~ one of the reflected optical signals, the ~~detectors~~ immersion lenses being located along the first optical axis.

58. (Previously Presented) An apparatus, as claimed in Claim 57, further comprising:

a number of second lenses, wherein a second lens is located between the reflective surface and the detector, the second lens reducing a wavelength of the reflected optical signal, whereby a spot size of the reflected optical signal is reduced after passing through the second lens.

59. (Canceled)

60. (Original) An apparatus, as claimed in Claim 59, wherein:

the plurality of detectors are positioned at spaced apart locations along an axis of the first lens.

61. (Original) An apparatus, as claimed in Claim 58, wherein:

the second lens is an immersion lens and a respective immersion lens is located between each of a plurality of detectors and the first lens to reduce a spot size associated with radiation converging on the respective detector.

62. (Original) An apparatus, as claimed in Claim 59, wherein:

at least some of the plurality of detectors are located in a hole in the first lens.

63. (Original) An apparatus, as claimed in Claim 59, wherein:

at least some of the plurality of detectors are located on a second side of the first lens, the second side being in an opposing relationship with the first side.

64. (Original) An apparatus, as claimed in Claim 59, wherein:

the plurality of detectors are located between the reflective surface and the first lens and along an axis of the first lens.

65. (Original) An apparatus, as claimed in Claim 59, wherein:

the first lens has an obscuration and at least one of the plurality of detectors is located in a shadow of the obscuration with respect to radiation having a wavelength different from a wavelength of radiation converging on the at least one detector.

66. (Original) An apparatus, as claimed in Claim 59, wherein:

at least one of the detectors is integral with the respective immersion lens.

67. (Original) An apparatus, as claimed in Claim 57, wherein the first lens has a focal length and the reflective surface is located at a distance from the first lens that is approximately equal to 50% of the focal length.

68. (Currently Amended) A method for receiving an optical signal transmitted through free space, comprising:

first passing the optical signal, the optical signal containing data, through a first lens to form a plurality of signal segments, each corresponding to a different median wavelength, wherein the first lens is a diffractive optical element;

second passing a portion of the optical signal through a phase retarder;

reflecting the plurality of signal segments off a reflective surface to form reflected radiation; and

detecting data in the reflected radiation at or near an optical focal point for each of the signal segments,

wherein the optical signal has a beam size that is less than a size of an inner scale in the vicinity of the source transmitter, and wherein passing a portion of the optical signal through a phase retarder reduces smear in the signal segments.

69. (Original) A method, as claimed in Claim 68, wherein:

in the first passing step a first portion of the optical signal is passed through a phase retarder.

70. (Original) A method, as claimed in Claim 69, wherein:

the first portion of the optical signal contacts a central portion of the diffractive optical element and wherein the first portion of the optical signal has a different phase than a second portion of the optical signal that is not passed through the phase retarder.

71. (Original) A method, as claimed in Claim 69, wherein:

said first portion is the radiation in the optical signal that contacts the diffractive optical element within a radial distance of a center of the at least one of a holographic unit, diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

72. (Original) A method, as claimed in Claim 68, wherein:

in the detecting step, each of the plurality of signal segments is detected by a different detector.

73. (Original) A method, as claimed in Claim 68, further comprising:

second passing the reflected radiation through a second lens to form converging radiation having a median wavelength different from the reflected radiation.

74. (Original) A method, as claimed in Claim 73, wherein:

the second lens is an immersion lens.

75. (Canceled)

76. (Previously Presented) A method, as claimed in Claim 68, wherein the beam size is no more than about 10 mm.

77. (Original) A method of manufacturing a detector assembly, comprising:

forming an optical detector on an at least substantially transparent substrate, the optical detector being on a first side of the substrate; and

forming, on an opposed second side of the substrate, a lens, the lens having a refractive index such that a median wavelength of radiation passing through the lens is reduced.

78. (Original) A method, as claimed in Claim 77, wherein the lens acts as an immersion lens.

79. (Original) A method, as claimed in Claim 77, further comprising:

providing a waveguide to provide electrical contact with the detector.

80. (Original) A method, as claimed in Claim 79, wherein the substrate is contacted with a waveguide and the ground plane of the waveguide has a width ranging from about 100 to about 1,000 microns, the conductor of the waveguide has a width ranging from about 5 to about 200 microns, and the distance between the conductor and the ground plane ranges from about 2 to about 100 microns.

81. (Original) A method, as claimed in Claim 79, wherein the substrate is contacted with a waveguide and the ground plane of the waveguide has a width of no more than about 2 mm waveguide, and the distance between the conductor and the ground plane is no more than about 50% of the width of the conductor.

82. (Original) A method, as claimed in Claim 77, wherein the curved surface has a radius of curvature ranging from about 300 to about 600 microns.

83. (Original) A method, as claimed in Claim 77, wherein an area of a photoactive region of the optical detector is no more than about 10% of an area of the curved surface.

84. (Original) A method, as claimed in Claim 77, wherein the second forming step comprises aligning the curved surface with the optical detector.

85. (Original) A method, as claimed in Claim 81, wherein the aligning step is performed by one or more of infrared microscopy, and mechanical metrology.

86. (Original) A method, as claimed in Claim 77, wherein the second forming step includes

engaging a mask with a surface of the substrate; and

etching the substrate to form the curved surface.

87. (Original) A method, as claimed in Claim 77, wherein the second forming step includes reducing a thickness of the substrate.

88. (Original) A method, as claimed in Claim 77, wherein in the first forming step a plurality of optical detectors are formed simultaneously on the substrate and in the second forming step a plurality of curved surfaces are formed simultaneously on the substrate and further comprising:

separating the substrate to form a plurality of discrete substrate portions, each including a optical detector and a curved surface.

89. (Original) A method, as claimed in Claim 77, further comprising:

bonding the substrate, including the optical detector and curved surface, to a second substrate.